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CROSSBREEDING INVESTIGATION IN THE PRODUCTION OF CALIFORNIA SPRING LAMBS

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CROSSBREEDING INVESTIGATION IN THE PRODUCTION OF CALIFORNIA SPRING LAMBS[1]

ROBERT F. MILLER[2]

INTRODUCTION

California is the leading state of the union in the production of spring lambs. Born in December and January, these lambs are ready for market in April and May. Although some were shipped east as early as 1898,[3] only within the last ten or twelve years has there been an extensive development of this branch of the sheep industry in California. The increase results from a seasonal shortage during April and May, when the market allows a premium on these "milk-fed" lambs. With improved railway facilities, sheepmen have found it profitable to ship to the great central markets of the Middle West.

The production of these lambs has involved many problems in breeding, feeding, care, and management. The first problem was that of changing the breeding period from October and November to July and August, which, of necessity, was a gradual transition over a period of years. In addition, crossbreeding is practiced in order to produce a market lamb of good quality. The breeding ewes are usually of grade Rambouillet or crossbred Rambouillet type. There are many breeds from which to select sires, and this question is continually confronting the sheepmen.

The next important problem is nutrition of the ewes lambing during the winter months, when natural forage or vegetation is limited. In most seasons, supplemental feed must be provided, particularly alfalfa hay and some concentrates. With great numbers of range sheep, this feed is a main source of expense, and careful attention is necessary if nutritional disorders are to be avoided.

A final production problem is the finishing period, when lambs are forced to early market weight and maturity. This requires an abundance of milk from the mothers and a choice type of green feed, preferably bur clover (*Medicago hispida*) and filaree (*Erodium cicutarium*

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[3]Voorhies, E. C., and W. E. Schneider. Economic aspects of the sheep industry. California Agr. Exp. Sta. Bul. 473:92–116. 1929. (Out of print.)

and *E. moschatum*) during the early spring months. Where green feed is scarce, some growers give the lambs a grain mixture by means of creeps. California spring lambs are a specialty product produced somewhat out of season, and producers should remember that the trade demands high quality.

The Early-Lamb District of the State.—The center of early lamb production is in the Sacramento and San Joaquin valleys. About 70 per cent of the California sheep population is found there, though not all the ewes are bred for early lambs. The leading counties shipping lambs east are

TABLE 1

CALIFORNIA SPRING-LAMB SHIPMENTS TO MIDWESTERN AND EASTERN MARKETS

Year	Lambs shipped alive	Lambs shipped dressed	Feeder lambs	Year	Lambs shipped alive	Lambs shipped dressed	Feeder lambs
1925	254,100	75,889	0	1931	446,493	68,538	15,000
1926	228,560	59,019	0	1932	443,605	25,039	0
1927	369,553	57,551	0	1933	437,271	10,500	17,300
1928	384,260	60,787	0	1934	444,617	650	52,000
1929	520,274	58,296	0	1935	5 6,346	5,200	4,000
1930	476,680	22,656	15,000				

Data furnished by W. E. Schneider, U. S. Department of Agriculture, Bureau of Agricultural Economics, Market News Service, San Francisco, California.

Glenn, Colusa, Butte, Yolo, Fresno, and Kern. Important requisites are mild winter weather, with green feed, and an abundance of choice spring feed for finishing. The Imperial Valley in the extreme southern part of the state also produces a considerable number; and usually the first California lambs shipped to the eastern markets originate in that section.

As shown by table 1, approximately one-half million spring lambs are shipped out of California annually. About fifty thousand of these were formerly sent by express as dressed lambs; but beginning with 1932 these shipments have been decreasing annually. Table 1 further indicates that feeder lambs have been forwarded in larger numbers during 1933 and 1934.

Type of Ewe.—A ewe well adapted for spring lamb production is the large smooth-bodied Rambouillet. This type is hardy, long-lived, easily herded, and a good wool producer; it possesses the all-important quality of breeding early. There is no difficulty in breeding these ewes when on good feed during July, and some growers even breed as early as June. A criticism of the breed is that the ewes lack somewhat in milking qualities.

Certain sheepmen prefer a crossbred ewe, one carrying perhaps a fourth long-wool blood, such as a Corriedale-Rambouillet or a Romel-

dale[4]-Rambouillet cross. Still others prefer the Romney-Rambouillet combination. The cross-bred ewes have a superior mutton conformation, are free from wrinkles or folds, and shear a longer fleece of wool than the fine-wool type, although they do not breed quite so early in the summer.

The Dorset Horn is an exception as a mutton breed in that it possesses the early breeding quality and may even breed twice a year. It has never become popular in California, however, for it is not adapted to range purposes and produces a light wool clip.

Type of Ram.—The four standard mutton-type sires used in California are the Hampshire, Suffolk, Shropshire, and Southdown. The first two are the most popular at the present time; their merits are well known. The Shropshire was at one time the most popular mutton breed in the state. The Southdown has been gaining in numbers rather rapidly, particularly in the north coast counties. The Romney is the most common long-wool breed in California. The Rambouillet, the prevailing fine-wool breed, is the foundation of range sheep in the western states.

OUTLINE OF EXPERIMENT

Because of the importance of the California spring-lamb industry and the widespread interest in the merits of the various mutton sires for the production of crossbred lambs, a six-year breeding test was planned in order to study this question. It began July 1, 1927, and involved 120 Rambouillet ewes to be mated in lots of 20 with Hampshire, Suffolk, Shropshire, Southdown, Romney, and Rambouillet rams. The rams were rotated annually from one lot to another. Thus each lot of ewes was mated with each breed of sire by the time the experiment was completed, and any possible differences in the original segregation of the ewes were overcome. Two rams were provided for each lot to avoid the possibility of the failure of a certain lot of ewes to become settled in lamb in case one ram might prove to be a nonbreeder. A new set of yearling rams was used each season to guard against having a very prepotent sire in one breed or an inferior sire in another, throughout the test.

The ewes were bred during July and August so as to produce December and January lambs. The ewes and lambs were properly fed and cared for in conjunction with the college flock, receiving alfalfa hay and grain as required during the winter months. As soon as the green feed was available, the ewes and lambs were turned out on native grass

[4] The Romeldale was produced by crossing the Romney ram with Rambouillet ewes. This breed was developed in California, the original cross having been made twenty years ago. Rigid selection and a careful breeding program have been followed by the original breeder, and the Romeldale is becoming well established in this state, breeding very true to type.

pasture and finished on this feed by May 1. Both wether and ewe lambs were marketed.

The points investigated in this test were as follows:

1. The birth weight of lambs
2. The final weight of lambs
3. The rate of daily gain
4. The pounds of lamb raised per ewe
5. The comparative market grades of lambs
6. The comparative market grades of carcasses
7. The comparative market value of lambs
8. The comparative weight of dressed carcasses and respective yield
9. The ultimate wholesale selling value of the carcasses on the open market

Addition of Crossbred Type of Ewe.—The second year, June, 1928, 80 head of first-cross Romney-Rambouillet ewes of the same age (two years old) as the Rambouillet ewes were added to the experiment in order that these two types of ewes might be compared for the production of spring lambs. The comparison was instituted because of the claims made for these crossbred ewes and their increasing numbers in the state.

They were mated in lots of 20 to Hampshire, Suffolk, Shropshire, and Southdown rams in rotation over a period of four years and became a part of the original flock, using the rams employed for the Rambouillet ewes. For simplicity the Rambouillet ewes will be referred to as group A, and the Romney-Rambouillet ewes as group B.

MATERIAL AND METHODS

The Rambouillet ewes were selected from a band of 1,700 yearling ewes in the San Joaquin Valley. They were large-framed, smooth-bodied range ewes of uniform type. They arrived at the farm on July 2, 1927, were labeled in each ear with duplicate numbered tags, and were segregated into six uniform lots of 20 each. Five extras were purchased at the beginning; and in June, 1930, 15 additional ewes of corresponding age were obtained to be used as replacements when necessary. The Romney-Rambouillet ewes were purchased from a sheepman in Solano County, and were selected as two-year-olds from a band of about 300 head. In June, 1930, 5 additional ewes of equal age were obtained to replace ewes in this group that had died. The ewes were fed and cared for according to good farm-flock practices. In the summer they were grazed on Sudan-grass pasture; in the fall on dry bur-clover pasture. In the winter, in addition to pasture, they received alfalfa hay and some grain.

In the spring they were pastured on good native grasses and bur clover. Salt was provided at all times in granulated bricks.

The rams for this experiment were selected annually from the college flock, except the Suffolks, which were purchased. It was planned to select good representative rams of each breed and not exceptionally outstanding individuals. The first year, however, some of the college stud rams were used, and a prominent breeder in Idaho contributed the use of a very fine Suffolk.

Mating.—The first two years, the mating period began on July 1. The Rambouillet ewes bred readily during that month. The Romney-Rambouillet ewes added the second year, however, did not begin breeding until the latter part of July; and most of them bred during August. Hence, all breeding was postponed until July 15 the last three years while group B was included in the test in the hope that the lambs of the two groups of ewes would be more nearly of the same age. The general practice of "flushing" the ewes was followed. They were kept on dry feed during May and June and lost somewhat in flesh. The sheep were then turned into a field of good Sudan-grass pasture 10 days before breeding was started. They remained on this pasture throughout the mating period. The ewes were thrifty and gaining in weight during the period and produced high-percentage lamb crops each year.

The ewes were turned out as one lot in the evening and allowed to graze during the night. Because of the hot weather this arrangement was more satisfactory than grazing in the daytime. They were brought to the barn in the morning, separated into respective lots by passing through a four-way parting chute, and placed in separate corrals. The proper ram was then turned with each lot during the day. Two rams were used in each lot and were alternated daily. The brisket of the ram was painted in order that the breeding activity might be observed. In the evening the ewes returned to the field. The rams, meanwhile, were assembled in one corral and were fed alfalfa hay to keep them in proper breeding condition.

The mating period continued about 10 weeks. Thereafter, the ewes were turned into the regular sheep pasture, consisting of native dry feed, because by that time the Sudan-grass pasture was exhausted.

Lambing Period.—The first two years, and the last year, the lambing period extended from December 1 to February 1; the intermediate three years, from December 15 to February 15. About three weeks before lambing, the ewes were brought to the barn every evening and fed a small ration of grain and alfalfa hay. Those close to lambing were separated from the main band and handled accordingly. As a rule the ewes were taken out to pasture every day throughout the winter in order to

give them proper exercise and keep them in good active condition. After lambing they were fed a liberal ration of grain, hay, and sometimes corn silage, because little pasture was available during December and January. They had access to a well-bedded open shed at night and, as they lambed, were transferred with their lambs to the main sheep barn. Soon after birth the lambs were weighed, ear-tagged, and measured with a small steel tape. The body measurements taken were the circumference of head, shoulder, and chest. The object was to study the comparative sizes of the lambs at birth and, if possible, to determine whether any relation exists between size of lamb and difficulty in parturition.

The lambs were docked and castrated when 2 to 3 weeks old. As soon as they began to eat, they were provided with a grain mixture in a lamb creep. This was considered necessary because green feed was limited and because twins were numerous.

Spring Feed.—About February 5 the ewes with the older lambs were turned into a 65-acre native grass pasture. The green feed was usually fairly good, although supplemental feeding was necessary for both ewes and lambs. The ewes were fed a grain mixture in troughs in the field, and the lambs in a creep. Grain-feeding the ewes was usually discontinued about March 15, but the lambs had access to a creep as long as they would come in to eat. When spring feed (bur clover and native grasses) became plentiful, the lambs gradually stopped going into the creep.

The ewes and lambs remained on this type of feed until the lambs were finished—usually about April 20. For several seasons pasture was rented from neighboring farmers to insure sufficient feed to fatten the lambs properly.

Marketing.—When the lambs reached an average weight of 75 to 80 pounds and most of them appeared finished, a closing date was set preparatory to marketing. On this day the ewes and lambs were brought from the field early in the morning; the lambs were separated from the ewes and weighed individually to obtain their final weight. Next, the lambs were placed in a small pen to be carefully graded by hand-picking according to the respective market grades—Choice, Good, Medium, and Common—and were branded accordingly, 1, 2, 3, and 4. The yearly grading was done as far as possible by the same committee—namely, Mr. Forrest Taylor[5] of Swift & Co. and Mr. W. E. Schneider of the Federal State Market News Service, both of San Francisco.

The lambs were also appraised by the grading committee according to current market value as indicated in table 2. This table shows a

[5] Mr. L. Knollin and Mr. Harold Wilson substituted for Mr. Forrest Taylor in 1929 and 1931 respectively.

marked fluctuation in market price of lambs from 1928 to 1933. Choice lambs varied from $15.25 per hundredweight in 1929 to $4.50 per hundredweight in 1933, a decrease of 238.9 per cent. During the same period the actual sale price of choice dressed lambs in New York City decreased from $34.01 per hundredweight to $19.67 per hundredweight, a difference of only 72.9 per cent. It appears that in commercial channels there

TABLE 2

Yearly Value of Lambs and Carcasses by Grade

Grade	1928	1929	1930	1931	1932	1933
Appraised value of lambs on foot—dollars per cwt., ranch weights						
Choice	13.50	15.25	10.00	8.00	5.50	4.50
Good	13.00	14.25	9.00	7.00	5.00	4.25
Medium	12.50	12.00	7.00	6.00	4.50	3.75
Common	11.00	11.00	6.00	4.00	3.50	3.00
Actual selling price of carcasses at New York City—dollars per cwt.						
Prime	No	33.33	26.97	25.38	19.96	No
Choice	dressed	34.01	26.95	25.21	19.67	dressed
Good	lambs	33.54	26.54	22.93	19.56	lambs
Medium	shipped	33.13	25.74	19.04	16.28	shipped

exists a greater variation in the price of live lambs than in the price of dressed carcasses.

Table 2 indicates that the committee appraised the lambs on foot according to market grade, although the wholesale trade made but little discrimination in price in relation to grade of carcass.

All the lambs except the Common[6] grade were then shipped to Swift & Co., at South San Francisco, and slaughtered. Each carcass was properly tagged and weighed to determine the dressing percentage. After hanging in the cooler for 3 or 4 hours, the carcasses were graded into Choice, Good, Medium, and Common by Mr. H. Roth, expert lamb grader of Swift & Co. at San Francisco. During four years of the test the lambs were shipped by refrigerator car to New York and sold on the open market by Swift & Co. An individual account sales was rendered on the sale and weight of each carcass. Many of the larger carcasses weighing over 42 pounds were sold in halves and quarters, as is customary and advantageous. During four years the carcasses were also graded upon arrival at New York by Mr. B. F. McCarthy of the Bureau of Agricultural Economics to get further information as to grade and as to the way the carcasses shipped.

[6] The first year both the Medium and Common lambs were kept, but in succeeding years the Medium lambs were marketed with the Choice and Good grades.

A numerical index was determined for the grading of lambs and carcasses by applying certain arbitrary values—namely, Choice, 5; Good, 4; Medium, 3; Common, 2—and then computing the average value for the lot. In determining the grade index in the New York rating, the grades Prime and Choice were each given a value of 5 in order to be

TABLE 3

AVERAGE WEIGHT OF RAMS, EWES, YEARLY WOOL CLIP, AND PERCENTAGE LAMB CROP

Breed of sire	Average weight of rams, lbs.	Number of ewes			Average weight of ewes,* lbs.		Yearly wool clip per ewe, lbs.†	Percentage lamb crop‡
		Bred	Lambed	Died	Initial	Final		
Group A, Rambouillet ewes, six-year average								
Hampshire	187.6	112	102	3	143.7	140.3	13.5	135.2
Suffolk	168.8	112	92	5	144.5	137.9	13.5	134.0
Shropshire	162.8	112	98	9	144.1	143.5	13.4	127.4
Southdown	141.0	112	101	5	146.3	141.4	13.4	130.6
Romney	157.2	74¶	61	4	141.4	135.4	13.6	132.8
Rambouillet	166.2	112	102	5	142.9	139.5	13.4	137.4
Group B, Romney-Rambouillet ewes, four-year average								
Hampshire	184.8	80	69	5	141.6	144.5	11.0	128.0
Suffolk	164.8	79	70	1	138.5	142.1	10.7	126.6
Shropshire	160.5	80	73	0	138.2	142.5	10.7	130.0
Southdown	138.8	80	71	2	137.0	139.8	10.6	129.5

* The initial and final weights of ewes were taken on July 1 and May 1 respectively of each year, except the first year when the weight of group A was taken on September 1.

† In a scouring test conducted in the wool laboratory of the University of California, the shrinkage of the Rambouillet wool was 61.5 per cent and the Romney-Rambouillet wool 50.5 per cent. On this basis the average yearly production of scoured wool was practically equal, namely, 5.2 pounds per fleece in group A and 5.3 pounds in group B.

‡ Percentage lamb crop was determined on the basis of the annual number of lambs marked (docked and castrated) and the number of ewes on hand at marking time.

¶ The Romney cross only includes four years because the rams failed to settle the ewes during two years of the test.

comparable with the San Francisco figures. At New York this work was done in great detail, each grade being subdivided into Top, Average, and Low; the subdivisions are not shown in table 8. The New York grade represents the average for four years when the carcasses were sent to New York, whereas the San Francisco grading covers six years.

COMPARISON OF BREED SIRES—EXPERIMENTAL DATA

Table 3 gives general information regarding the number and weight of ewes, the yearly wool clip, and the representative weight of rams for both groups A and B. It shows that in group A there was considerable variation as to the total number of ewes that lambed. The initial weight

of the ewes in group A was higher than the final weight, although in group B the condition was reversed. Each lot included a large percentage of twins,[7] and group A exceeded group B in percentage lamb crop raised. The fecundity of both groups of ewes throughout the experiment was rather high. No doubt this is partly due to the fact that these ewes

TABLE 4

Weights and Distribution of Single and Twin Lambs

Sire	Total number lambs raised	Number single lambs	Number twin lambs*	Per cent twins dropped	Av. birth wt., lbs.		Av. final wt., lbs.	
					Single	Twin	Single	Twin
Group A, Rambouillet ewes, six-year average								
Hampshire	144	42	102	70.8	12.4	9.9	85.9	73.3
Suffolk	138	27	111	80.4	12.0	10.0	87.1	75.6
Shropshire	135	50	85	62.9	11.0	9.3	80.4	68.5
Southdown	141	49	92	65.2	10.0	8.7	79.1	65.8
Romney	89	27	62	69.6	11.0	9.0	76.1	67.4
Rambouillet	146	42	104	71.2	10.6	8.7	77.9	68.8
Average	...	..	...	70.1	11.2	9.3	81.1	69.9
Group B, Romney-Rambouillet ewes, four-year average								
Hampshire	96	41	55	57.3	12.6	9.2	76.2	64.4
Suffolk	100	40	60	60.0	11.5	9.7	75.0	65.3
Shropshire	103	37	66	64.1	10.2	8.9	66.0	60.7
Southdown	102	37	65	63.7	10.4	8.1	63.7	57.4
Average	...	..	..	61.3	11.2	9.0	70.2	61.9

* There were also 23 sets of triplets in group A during the six-year period and 5 sets in group B during the four-year period. The smallest or weakest lamb of each trio was always destroyed and the ewe allowed to nurse only two lambs, hence triplets are considered as twins. The distribution of triplets by sires in group A was as follows: Southdown 4 sets, Shropshire 3, Hampshire 6, Suffolk 3, Romney 1, and Rambouillet 6. In group B the Shropshire produced 2 sets, Hampshire 2, Suffolk 1, and Southdown 0.

were always in good condition and were on Sudan-grass pasture during the breeding period.

As shown in table 4, the average birth weight of the single lambs was about 2 pounds heavier than the twin lambs in both groups. In final weight the single lambs in group A weighed 81.1 pounds each while the twin lambs weighed 69.9 pounds, a difference of 11.2 pounds in favor of the single lambs. In group B the corresponding difference was 8.3 pounds, a smaller difference, primarily because these lambs were 21.3 days younger, as shown in table 10.

Lamb Weights, Group A.—Considering group A (table 5), the Hamp-

[7] There were a number of sets of triplets annually except the first year, but the weakest lamb was always destroyed and the ewe allowed to nurse only two lambs. For that reason triplets do not enter into the following discussion but on the other hand will be considered as twins.

shire[8] lambs were a trifle heavier at birth than the Suffolk; and the remaining crosses rank, Shropshire, Romney, Rambouillet, and Southdown. In final weight of lamb the Suffolk exceeded the Hampshire, although the difference was small, 1.3 pounds per lamb. The Shropshire lambs in turn were 4.1 pounds lighter than the Hampshire and the

TABLE 5

WEIGHT, AGE, DAILY GAIN AND VALUE PER LAMB; POUNDS OF LAMB PRODUCED PER EWE

Breed of sire	Number of lambs	Average weight of lambs, lbs.		Average age lamb, days	Average daily gain, lbs.	Pounds lamb per ewe*	Appraised value per lamb, dollars†
		Birth	Final				
Group A, Rambouillet ewes, six-year average							
Hampshire	144	10.6±0.11¶	77.0±0.68¶	121.0	0.548	99.0	6.71
Suffolk	138	10.4±0.10	78.3±0.76	120.3	0.564	96.5	6.51
Shropshire	135	9.8±0.10	72.9±0.67	116.8	0.540	87.9	6.46
Southdown	141	9.5±0.11	70.4±0.67	118.1	0.515	88.7	6.00
Romney	89‡	9.6±0.13	70.0±0.84	115.0	0.525	84.2	0.00§
Rambouillet	146	9.6±0.10	70.7±0.62	119.9	0.509	92.1	5.52
Group B, Romney-Rambouillet ewes, four-year average							
Hampshire	96	10.6±0.17	69.5±0.92	95.8	0.615	83.5	5.91
Suffolk	100	10.3±0.13	69.2±0.85	96.2	0.612	87.6	6.17
Shropshire	103	9.4±0.11	62.6±0.91	94.4	0.563	80.6	5.06
Southdown	102	9.1±0.13	60.4±0.67	92.4	0.555	77.0	5.36

* Pounds of lamb produced per ewe represents the pounds of lamb at marketing time credited to each ewe annually. This is based on the total weight of lambs and the total number of ewes bred during the six-year period.

† This is the average value at Davis at the close of each year as determined by the committee who evaluated the lambs annually on basis of market grade (see table 2, p. 9).

‡ This represents only four years because the rams failed to settle the ewes during two years.

§ Value of Romney cross omitted because the results of four years are not comparable to the other lots on account of market fluctuations.

¶ The probable error is given mainly for the technical worker.

Southdown 2.5 pounds lighter than the Shropshire. The Romney and Rambouillet lambs were about equal to the Southdown, the average weight of these three crosses varying from 70.0 to 70.7 pounds per lamb.

In daily gain the same general relation prevailed as the various crosses were of approximately the same average age. Figure 1 shows the monthly gain of each cross to be fairly uniform. The lambs of each cross made the greatest gain during the last month.

In pounds of lamb produced per ewe, all the lots made a favorable showing. The Hampshire cross produced 99.0 pounds, and the Suffolk 96.5 pounds per ewe annually. The Rambouillet, although a fine wool breed, stood third, 92.1 pounds, because this lot produced the largest

[8] For the sake of brevity, each cross within a group is referred to by the sire's breed only in comparing the various lots of lambs throughout this publication.

number of lambs during the six-year period. The Southdown excelled the Shropshire by a small margin owing to the fact that the former produced 141 lambs and the latter 135 lambs. The Romney cross stood last, which may have been due to the fact that this cross had to be eliminated during two years when feed conditions were favorable.

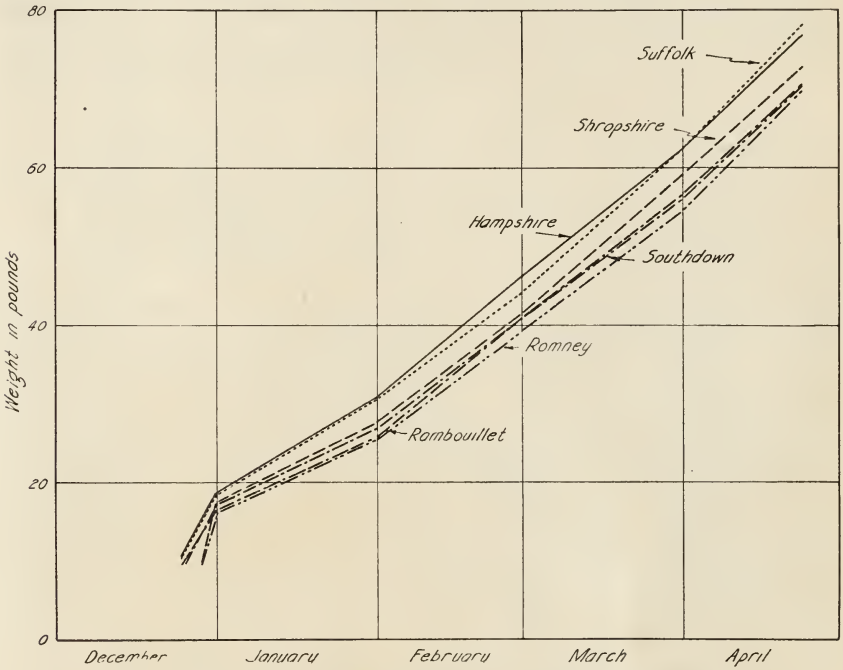

Fig. 1.—Monthly gain of lambs of each cross for six-year period, group A (Rambouillet ewes).

In the appraised value per lamb, based on the market value by grade, the Hampshire average value was $6.71 and the Suffolk $6.51. The Shropshire ranked next, followed by Southdown and Rambouillet.

Significance of the Difference of the Mean Final Weights of Lambs, Group A.—In order to determine whether the differences found are significant, the usual mathematical formula has been applied. Comparing the final weights of lambs of various breeds, we obtain the following results:

Breeds compared	Mean difference, in pounds
Hampshire and Shropshire	4.06 ± 0.954
Suffolk and Shropshire	5.39 ± 1.013
Hampshire and Southdown	6.57 ± 0.954
Suffolk and Southdown	7.9 ± 1.013
Hampshire and Rambouillet	6.31 ± 0.922
Suffolk and Rambouillet	7.64 ± 0.982

These differences are in every case significant. Similarly, comparing some of the other breeds where less difference exists, we obtain the following results: Hampshire and Suffolk, mean difference $= 1.33 \pm 1.02$ pounds, Shropshire and Southdown, mean difference $= 2.51 \pm 0.996$ pounds, Shropshire and Rambouillet, mean difference $= 2.25 \pm 0.914$ pounds. These differences are too small to be significant and may be disregarded.

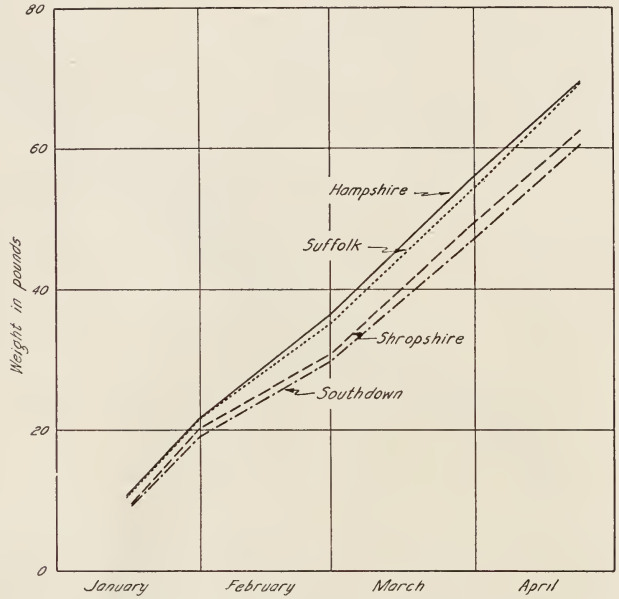

Fig. 2.—Monthly gain of lambs of each cross for four-year period, group B (Romney-Rambouillet ewes).

Lamb Weights, Group B.—Referring next to group B (table 5), the Hampshire lambs were a trifle heavier at birth than the Suffolk, and the Shropshire and Southdown were in turn about 1 pound lighter than the Suffolk. In average final weight of lambs, the Hampshire and Suffolk were practically equal and excelled the Shropshire and Southdown by approximately 7 and 9 pounds, respectively. The lambs sired by Hampshire and Suffolk rams made a particularly heavy gain at the finishing period, some of them gaining as much as 1 pound a day.

The daily and monthly gains per lamb (fig. 2) were in the same order as the final weight, since the lambs were of practically the same age. In pounds of lamb produced per ewe on the basis of the total number of ewes bred, the Suffolk excelled the Hampshire by 4.1 pounds per ewe, the weights being 87.6 and 83.5 pounds respectively. The Shropshire cross excelled the Southdown by 3.6 pounds, the former producing 80.6 pounds and the latter 77.0 pounds per ewe.

In the appraised value per lamb at Davis, determined on the basis of grade on foot, the Suffolk stands first, with a value of $6.17 per lamb; the Hampshire next, with $5.91; the Southdown with $5.36; the Shropshire with $5.06.

Significance of the Difference of the Mean Final Weights of Lambs, Group B.—As in group A, the mathematical formula for determining the significance of the difference in the final weight of lambs has been applied, with the following results:

Breeds compared	Mean difference, in pounds
Hampshire and Shropshire	6.94 ± 1.29
Suffolk and Shropshire	6.63 ± 1.24
Hampshire and Southdown	9.18 ± 0.944
Suffolk and Southdown	8.87 ± 0.875

These differences are in every case significant. When, however, the Hampshire and the Suffolk or the Shropshire and the Southdown are compared, the differences are not significant.

Grade of Lambs on Foot.—In group A (table 6), nearly 93 per cent of the Southdown lambs were marketed, approximately 88 per cent of Shropshire and Suffolk, 86 per cent of Hampshire, 78 per cent of Romney and 70 per cent of Rambouillet. (Only the Choice, Good, and Medium were included in the number of lambs marketed except in the first year; the Common lambs were classed as feeders and were not shipped.) These figures show that a very good percentage of lambs, in the mutton crosses, were finished for market each year and that the Southdown readily leads. Furthermore the Southdown excelled in percentage of Choice lambs, namely, 34.05 per cent. The number of lambs and of carcasses in each grade is shown in figure 3. According to the numerical grade index, which is a definite expression of quality, the breeds rank Southdown, Shropshire, Hampshire, Suffolk, Romney, and Rambouillet.

With reference to the percentage of lambs marketed in group B, the Southdown cross again leads, with 91 lambs marketed out of a total of 102 raised, or 89.2 per cent. The Hampshire follows with 87.5 per cent, the Suffolk with 86.0 per cent, and the Shropshire with 83.5 per cent. This is a very good percentage of lambs ready for market, considering the large number of twins raised and the average age of only about 95 days. In grade of lamb on foot, as shown by the numerical grade index, the breeds ranked, Southdown, Suffolk, Hampshire, and Shropshire in group B. In both groups A and B the Southdown excelled, but the positions of the Shropshire and Suffolk were reversed in the two groups. The distribution of grades is shown graphically, both for lambs on foot and for carcasses, in figure 4.

Dressed Yield and Grade of Carcass.—In dressed weight of carcass in group A (table 7) the Suffolk was a trifle heavier than the Hampshire, and the Shropshire and Southdown were 2.7 and 3.4 pounds lighter than the Suffolk. The Romney and Rambouillet were about equal, both being about 4 pounds lighter than the Suffolk.

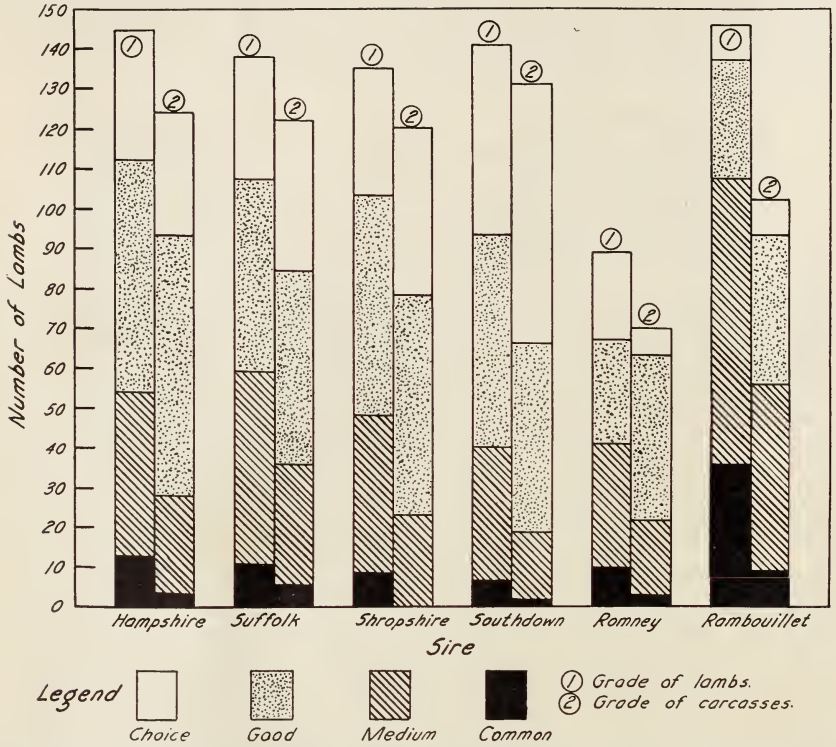

Fig. 3.—Distribution of grade of lambs and grade of carcasses of each cross for six-year period, group A (Rambouillet ewes).

In dressed yield the Southdown and Shropshire made the most favorable showing in group A, yielding 51.6 and 51.0 per cent respectively. The Hampshire and Suffolk were about equal, 49.9 and 50.0 per cent; and the Romney and Rambouillet were last, 48.9 and 48.4 per cent, partly because they have a heavier pelt, which increases the offal.

The grade of carcass in group A (fig. 3) was distinctly higher than the grade on foot, partly because the lambs were shipped one week after being graded on foot. The Southdown cross readily leads with nearly 50 per cent Choice lambs. According to the grade index the breeds ranked Southdown, Shropshire, Hampshire, Suffolk, Romney, and Rambouillet.

Considering group B (table 7), we find a relation similar to that in group A: the Southdown again leads in dressed yield—52.1 per cent—

and shows a large percentage of Choice lambs—70.3 per cent. The carcasses graded higher in group B (fig. 4) than in group A, although the same general relation prevailed. According to the grade index the breeds in group B ranked Southdown, Hampshire, Shropshire, and Suffolk.

Table 8 gives the result of the grading and sale of the carcasses during the four years in which they were shipped to New York City. When

TABLE 6

Percentage of Lambs Marketed, Percentage of Each Grade, and Grade Index

Breed of sire	Number of lambs		Per cent of lambs marketed†	Percentage of each grade				Grade index*
	Raised	Marketed		Choice	Good	Medium	Common†	
Group A, Rambouillet ewes, six-year average								
Hampshire	144	124	86.11	22.75	40.00	28.28	8.97	3.76
Suffolk	138	122	88.41	22.46	34.78	34.78	7.98	3.71
Shropshire	135	120	88.88	23.71	40.74	28.89	6.66	3.81
Southdown	141	131	92.98	34.05	37.59	23.40	4.96	4.01
Romney	89	70	78.65	24.72	29.21	34.84	11.23	3.67
Rambouillet	146	102	69.86	6.16	20.55	48.64	24.65	3.08
Group B, Romney-Rambouillet ewes, four-year average								
Hampshire	96	84	87.50	26.04	30.22	32.29	11.45	3.71
Suffolk	100	86	86.00	28.00	33.00	27.00	12.00	3.77
Shropshire	103	86	83.50	14.56	33.98	37.87	13.59	3.50
Southdown	102	91	89.21	29.42	34.31	25.49	10.78	3.82

* The grade index is a measure of quality determined by assigning an arbitrary value to each grade—Choice 5, Good 4, Medium 3, and Common 2—and calculating the average.

† The first year only the lambs grading Choice and Good were marketed, the Medium and Common lambs were classed as feeders. In the succeeding years only the Common lambs were classed as feeders. This accounts for the discrepancy in regard to the percentage of lambs marketed and the percentage of lambs grading Common.

these results are compared with table 7, the grading of group A appears to be distinctly higher in the East than in San Francisco. The former, however, represents four years and the latter six years. Furthermore, the carcasses lacked somewhat in quality during 1928 and 1933, the two years not included in the New York grading. The same general order prevailed in that the Southdown and Shropshire carcasses excelled in group A although in group B the Shropshire carcasses graded lower than the Suffolk but excelled the Hampshire.

The average sale price per hundredweight was somewhat contrary to expectations, as only a small premium was allowed on the better-quality Southdown and Shropshire lambs. These two lots sold at an average price of $26.07 and $25.98 per hundredweight respectively, while the Hampshire and Suffolk brought $25.41 and $24.60 respectively. The Rambouillet carcasses, furthermore, averaged $24.94, although this is

classed as a wool breed and the grade was considerably lower than the mutton crosses. This would indicate that the wholesale trade does not discriminate as closely as is usually expected in reference to quality of carcass. In the gross value per carcass (group A) the Hampshire excelled, $10.10; the Suffolk $9.69, the Shropshire $9.53, the Southdown $9.46, and the Rambouillet $9.01. In group B the Hampshire and Suffolk

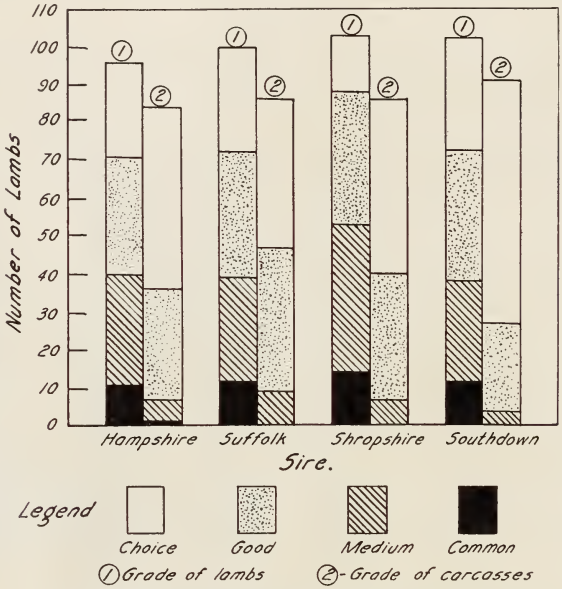

Fig. 4.—Distribution of grade of lambs and grade of carcasses of each cross for four-year period, group B (Romney-Rambouillet ewes).

were practically equal in this respect although the Southdown carcasses brought considerably more than the Shropshire in this group.

Grade of Carcass in Relation to Weight and Price.—Regarding the value and grade of carcass at New York, a definite relation appears to exist between the market grade and the weight of carcass in both groups A and B. In every cross the Prime carcasses were the heaviest with a gradual decrease in weight from Prime to Medium as shown in table 9. The variation was smallest in the Southdown and greatest in the Hampshire and Suffolk. To secure superior finish, a carcass must be well covered and within certain limits the heaviest lambs graded the highest. On the other hand, carcasses that weighed above 50 pounds apiece were penalized and placed in the Good grade instead of Choice where they would have otherwise belonged.

There was a less definite variation in the sale price per hundredweight of the carcasses. The Prime and Choice grades sold for practically the

TABLE 7

Dressed Weight, Dressed Yield, and Grading of Carcasses at San Francisco

Breed of sire	Number of lambs marketed	Average dressed weight, lbs.	Average dressed yield, per cent	Percentage of each grade				Grade index*
				Choice	Good	Medium	Common	
Group A, Rambouillet ewes, six-year average								
Hampshire	124	41.2	49.9	25.0	52.4	19.3	3.3	3.99
Suffolk	122	41.7	50.0	31.1	39.4	24.6	4.9	3.96
Shropshire	120	39.0	51.0	35.0	45.8	19.2	0.0	4.16
Southdown	131	38.3	51.6	49.6	35.9	13.0	1.5	4.34
Romney	70	37.2	48.9	10.0	58.5	27.2	4.3	3.74
Rambouillet	102	37.1	48.4	8.8	36.3	46.1	8.8	3.45
Group B, Romney-Rambouillet ewes, four-year average								
Hampshire	84	38.5	51.3	57.1	34.5	7.2	1.2	4.47
Suffolk	86	38.3	51.1	45.4	44.2	10.5	0.0	4.35
Shropshire	86	34.5	51.2	53.5	38.4	8.1	0 0	4.45
Southdown	91	33.5	52.1	70.3	25.3	4 4	0 0	4 66

* The grade index was determined on the same basis as in table 6.

TABLE 8

Sale Price and Grading of Carcasses at New York City

Breed of sire	Number of carcasses shipped	Sale price, dollars		Percentage of each grade				Grade index*
		Per cwt.	Per carcass	Prime	Choice	Good	Medium	
Group A†, Rambouillet ewes, four-year average								
Hampshire	95	25.41	10.10	6 3	45 3	37.9	10.5	4 41
Suffolk	99	24.60	9.69	6.1	34 4	35.3	24.2	4.16
Shropshire	91	25.98	9.53	9.9	46.1	33.0	11 0	4.45
Southdown	99	26.07	9.46	14.1	45.5	30.3	10.1	4.50
Rambouillet	73	24.94	9.01	2.7	28.8	38.4	30.1	4.01
Group B, Romney-Rambouillet ewes, four-year average								
Hampshire	84	26.10	9.13	10 7	32.1	39.3	17.9	4.25
Suffolk	86	25.61	9.12	5.8	39.6	43.0	11.6	4.34
Shropshire	86	26.17	8.25	9.4	37.6	35.3	17.7	4.29
Southdown	91	26.37	8.61	14.3	46.1	27.5	12.1	4.48

* In determining the grade index of carcass in New York the grade Prime was given a value of 5, the same as Choice, in order to be comparable with tables 6 and 7.

† The Romney cross is omitted in group A since the data was missing during two years when the ewes failed to lamb.

TABLE 9

GRADE OF CARCASS IN RELATION TO WEIGHT* AND PRICE,* NEW YORK

Grade of carcass	Hampshire			Suffolk			Shropshire			Southdown			Rambouillet		
	Carcasses	Average weight, pounds	Price, dollars per cwt.	Carcasses	Average weight, pounds	Price, dollars per cwt.	Carcasses	Average weight, pounds	Price, dollars per cwt.	Carcasses	Average weight, pounds	Price, dollars per cwt.	Carcasses	Average weight, pounds	Price, dollars per cwt.
Group A, Rambouillet ewes, four-year average															
Prime....	6	46.0	26.49	6	48.5	25.85	9	43.2	26.65	14	40.7	26.80	2	44.0	26.67
Choice...	43	41.7	25.95	34	40.9	25.55	42	39.1	26.75	45	37.6	26.79	21	40.2	26.66
Good.....	36	37.9	25.41	35	39.6	25.11	30	33.3	25.85	30	34.0	25.97	28	36.1	24.89
Medium..	10	33.4	23.02	24	35.1	22.82	10	30.2	24.10	10	30.5	23.25	22	31.9	23.44
Group B, Romney-Rambouillet ewes, four-year average															
Prime....	9	43.7	26.11	5	46.8	25.18	8	37.0	26.53	13	35.2	26.39	No Rambouillet cross in Group B		
Choice...	27	41.2	26.64	34	38.9	24.51	32	35.6	26.60	42	34.2	26.69			
Good.....	33	35.0	25.51	37	35.5	24.98	30	31.6	25.54	25	31.4	26.00			
Medium..	15	30.9	24.68	10	31.7	23.25	16	29.7	24.45	11	30.2	24.14			

* This table shows the average weight per carcass and the average wholesale price per hundredweight on a total of 457 lambs in Group A and 347 lambs in group B.

same amount in group A, while in group B the Choice lambs outsold the Prime lambs in three of the four crosses. The Choice grade of carcasses was in general somewhat higher in price than the Good grade and the Good grade in turn sold on an average about $1.50 per hundredweight higher than the Medium grade. The variation, however, was not as great as is usually anticipated in trade channels.

COMPARATIVE PRODUCTION OF GROUP-A AND GROUP-B EWES

At the outset it should be stated that the average date of breeding for group A was August 1; for group B, August 21. The first year of the comparison the rams were put with the ewes on July 1, but because the group-B ewes bred very much later than the group-A ewes it was thought best to postpone the breeding date about two weeks, and the rams were not turned with the ewes until July 15 for the following three years. As shown in table 10, the lambs in group A were on an average 21.3 days older than those in group B and this difference in age of lambs should be kept in mind when comparing the production of the two types of ewes.

In yearly wool clip group-A ewes produced 2.7 pounds more grease wool per head than those of group B, although on a scoured basis with the shrinkage as given in the footnote of table 10 the two groups produced practically an equal amount of scoured wool. The wool from group A graded 64/70's in quality and from group B 56's. If the two types of wool were evaluated on the scoured basis the Rambouillet would yield a somewhat greater return because of the finer grade.

During the four-year period a larger number of lambs were raised in group A than group B, owing to a larger percentage of twins. The average birth weight of lamb was about the same, but in final weight the lambs out of the group-A ewes were 9 pounds per head heavier primarily because of greater age. In daily gain the lambs out of group-B ewes excel; and if the final weight is adjusted for an equal age—namely, assuming that both lots were 115.9 days old—the difference would be in favor of the latter by about 4 pounds per lamb.

When the grade of lamb on foot is considered, there was but little difference, but in grade of carcass the lambs out of the group-B ewes were superior, as shown by the grade index 4.43 as compared to 3.99. They also yielded a higher percentage when dressed, and the average sale price per hundredweight was $1.05 higher on the New York market. The appraised value per lamb at Davis and the average value per carcass of group-A lambs is higher than for group-B lambs, because of greater age due to the early breeding quality of the group-A ewes.

BODY MEASUREMENTS OF LAMBS AT BIRTH

The object of these measurements was to compare the size of the respective lambs in order to study the influence of the various breed sires on the size of the lamb at birth and the possible relation between size of lamb

TABLE 10

PRODUCTION OF THE TWO TYPES OF EWES BRED TO HAMPSHIRE, SUFFOLK, SHROPSHIRE, AND SOUTHDOWN RAMS (FOUR YEARS)

		Rambouillet ewes (group A)	Romney-Rambouillet ewes (group B)
Number of ewes bred		77	80
Number of ewes lambed		68	71
Yearly wool clip—grease weight, lbs.		13.5	10.8
Yearly wool clip—scoured weight,* lbs.		5.2	5.3
Average yearly weight of ewes, lbs.		144.9	142 4
Number of lambs raised		412	401
Per cent of twins born		76.1	61.6
Per cent of lamb crop raised		132.2	128 5
Average birth weight of lambs, lbs.		9.8	9 9
Average final weight of lambs, lbs.		74.4	65 4
Average age per lamb, days		115.9	94 6
Final weight of lambs computed at equal age,† lbs.		74 4	78 2
Average daily gain of lambs, lbs.		0.561	0.599
Pounds of lamb per ewe		91.4	82.2
Average appraised value at Davis, dollars		6.43	5.62
Per cent in each grade, lambs on foot at Davis	Choice	22.5	24.5
	Good	41.4	32.9
	Medium	29.3	33 4
	Common	6-8	11.9
Grade index of lambs, Davis		3.67	3.64
Per cent in each grade, carcasses at San Francisco	Choice	40.3	56.6
	Good	44 5	35 6
	Medium	14 7	7.5
	Common	0.5	0.3
Grade index of carcasses, San Francisco		3.99	4.43
Dressed weight of carcass, lbs.		39.56	36.19
Dressed yield, per cent		49.79	51.40
Average sale price per cwt. at New York City, dollars		25.51	26.56
Average value of carcass at New York City,‡ dollars		9.69	8.78

* The shrinkage of the Rambouillet wool was 61.5 per cent and the Romney-Rambouillet wool 50.5 per cent.

† For the sake of comparison, the weight of the group-B lambs was adjusted, on the basis of the average daily gain, to the weight they would have attained at the same age as group A.

‡ The average value of carcass was compiled from the actual sale of all carcasses.

and difficult parturition. Three observations were recorded—namely, circumference of head, shoulder, and chest or heart girth. The measurements were taken with a steel tape, special care being exercised to make them as uniform and accurate as possible.

The data in table 11 indicate that there are differences in certain body measurements of lambs produced by various breed sires. These differences are analyzed more completely in table 12 for the use of the tech-

nical worker. Within group A the circumference of head of the Hampshire lambs is greater than that of the lambs produced by any of the other sires, and, although the differences may appear small statistically, they are significant. The Southdown is smaller than the Shropshire. The other breeds show no significant differences in size of head.

TABLE 11

Body Measurements of Lambs at Birth

Sire	Number of lambs	Average head* circumference, cm	Average shoulder† circumference, cm	Average chest‡ circumference, cm
		Group A		
Hampshire	158	26.2±0.087	37.3±0.173	37.1±0.155
Suffolk	148	25.6±0.091	37.3±0.153	37.2±0.136
Shropshire	149	25.9±0.091	36.8±0.158	36.6±0.135
Southdown	149	25.4±0.087	36.3±0.171	36.1±0.159
Romney	92	25.6±0.129	36.3±0.201	36.6±0.207
Rambouillet	160	25.6±0.078	36.3±0.158	36.1±0.135
		Group B		
Hampshire	96	25.6±0.113	37.0±0.218	37.0±0.222
Suffolk	100	24.9±0.103	37.6±0.187	36.8±0.186
Shropshire	103	24.6±0.092	36.6±0.172	35.8±0.163
Southdown	102	24.4±0.099	36.3±0.202	35.6±0.178

* The circumference of the head was taken by passing a tape around the head just above the eyes and under the lower jaw at the junction of the throat. This measurement was definite and subject to very slight error.

† The circumference of the shoulder was taken by passing a tape over the top of the shoulder and around the body just in front of the forelegs. This measurement was definite but subject to more error than the head measurement.

‡ The circumference of the chest, taken by passing a tape around the body just back of the forelegs, represents a transverse vertical plane. This was a very satisfactory measurement and subject to very slight error.

In shoulder measurements of group-A lambs, the Hampshire and Suffolk are practically equal. Both of these breeds are distinctly larger than the Southdown, Romney, and Rambouillet. They are also larger than the Shropshire, but the difference is hardly significant. There are no marked differences in the progeny of the other sires.

In circumference of chest, the Hampshire and Suffolk group-A lambs are practically equal. When either breed is compared with Southdown or Rambouillet in chest measurement, the differences are highly significant. When other comparisons are made, there are no significant differences. This analysis indicates a strong similarity in body conformation between the Hampshire and Suffolk, although there is a definite difference in head size.

Within group B, the Hampshire is larger in circumference of head than the Suffolk, Shropshire, and Southdown. The Suffolk is larger than

the Southdown. The differences between the Suffolk and Shropshire and between the Shropshire and Southdown are not significant. In circumference of shoulder the differences are not significant except in case of the Suffolk, which is larger than the Shropshire and Southdown. In chest

TABLE 12

THE MEAN DIFFERENCES AND THE PROBABLE ERROR OF THE BODY MEASUREMENTS OF LAMBS AT BIRTH

Sires compared	Head circumference, cm	Shoulder circumference, cm	Chest circumference, cm
Group A			
Hampshire-Suffolk	0.6±.126*	0.0	0.1±.206
Hampshire-Shropshire	0.3±.126	0.5±.234	0.5±.205
Hampshire-Southdown	0.8±.123*	1.0±.243*	1.0±.222*
Hampshire-Romney	0.6±.155*	1.0±.265*	0.5±.258
Hampshire-Rambouillet	0.6±.117*	1.0±.234*	1.0±.205*
Suffolk-Shropshire	0.3±.128	0.5±.219	0.6±.191
Suffolk-Southdown	0.2±.126	1.0±.229*	1.1±.209*
Suffolk-Romney	0.0	1.0±.252*	0.6±.247
Suffolk-Rambouillet	0.0	1.0±.219*	1.1±.191*
Shropshire-Southdown	0.5±.126*	0.5±.232	0.5±.208
Shropshire-Romney	0.3±.158	0.5±.255	0.0
Shropshire-Rambouillet	0.3±.120	0.5±.223	0.5±.190
Southdown-Romney	0.2±.155	0.0	0.5±.260
Southdown-Rambouillet	0.2±.117	0.0	0.2±.208
Romney-Rambouillet	0.0	0.0	0.5±.246
Group B			
Hampshire-Suffolk	0.7±.153*	0.6±.287	0.2±.289
Hampshire-Shropshire	1.0±.146*	0.4±.277	1.2±.275*
Hampshire-Southdown	1.2±.150*	0.7±.294	1.4±.284*
Suffolk-Shropshire	0.3±.138	1.0±.253*	1.0±.247*
Suffolk-Southdown	0.5±.143*	1.3±.283*	1.2±.257*
Shropshire-Southdown	0.2±.135	0.3±.265	0.2±.241
Comparing group-A and group-B ewes			
Hampshire sire	0.6±.143*	0.3±.278	0.1±.270
Suffolk sire	0.7±.137*	0.3±.241	0.4±.230
Shropshire sire	1.3±.130*	0.2±.233	0.8±.211*
Southdown sire	1.0±.132*	0.0±.264	0.5±.238

* Indicates that the difference is significant.
Source of data: tables 10 and 11.

measurement the Hampshire and Suffolk are about equal and significantly larger than the Shropshire and Southdown. There is no appreciable difference between the Shropshire and Southdown.

When the two groups of ewes are compared as to size of lambs, the Rambouillet ewes consistently produced lambs with larger heads than the Romney-Rambouillet ewes. This was true in case of each breed sire

and would indicate that the larger-framed Rambouillet ewes were contributing more to the size of head of their offspring than the group-B ewes. There were, however, no significant differences in the measurement of shoulder of the lambs produced by these two types of ewes. The same is true for the chest measurement except that the Rambouillet ewes produced lambs with a definitely greater chest circumference when mated with Shropshire sires than the Romney-Rambouillet ewes.

In general there is a correlation between the body measurements at birth and the final weight of the lambs. This is more pronounced in shoulder and chest measurements. It is also fairly well shown in the head measurement except in case of the Suffolk, which has a smaller head in relation to the other two body measurements.

Observations were made throughout the six years as to the ease of parturition among the various crosses. Each year there were a few cases of difficult parturition, and these were distributed evenly among the various lots. The preponderance of twins resulted in smaller lambs and easier lambing. George Philip, the shepherd constantly in charge, found that the ewes bred to Hampshire and Suffolk sires lambed as readily as those bred to Shropshire and Southdown. These were, however, large, well-developed Rambouillet and crossbred ewes, well adapted to mating with the larger breeds of rams. The ewes were maintained in thrifty condition and always allowed ample exercise, which is an important factor in management.

MONTHLY WEIGHT OF EWES

Figure 5 shows the monthly fluctuation of the weight of ewes from September 1, 1927, to May 1, 1933. This chart is a very good demonstration of how these ewes increased in weight during the summer and fall, including gestation. They usually reached the peak about December 1, when they began to lamb. Then followed a sharp decrease in weight caused by lambing and lactation and extending to April 1. At this stage the ewes began to gain because of a good supply of green feed and a decrease in the milk flow during the latter part of lactation. The lambs were always weaned about April 20, and after weaning came a sharp increase in weight that continued throughout the summer and fall. Both groups of ewes showed the same trend in the annual weight cycle (fig. 5).

It would also appear that range ewes continue to gain up to three or four years of age when placed on a higher plane of nutrition as compared with range conditions. The average weight of the Rambouillet ewes on September 1, 1927, at approximately 18 months of age, was 126.6 pounds per head. On December 1, 1928, they weighed 155.1 pounds; and on December 1, 1929, 172.2 pounds, which was approximately the

maximum weight of these ewes. The Romney-Rambouillet ewes increased in a similar manner: On August 1, 1928, one month after they arrived at the farm as two-year-olds, they weighed 129.0 pounds per head; on December 1, 1929, they weighed 159.5 pounds; and on December 1, 1930, 168.2 pounds, which was the maximum weight for this group. This chart well illustrates the favorable seasonal change in the monthly weight of breeding ewes kept under proper feed conditions.

DISCUSSION

This experiment was a comparison of six breeds of sires when mated with straight-bred Rambouillet ewes and of four breeds of sires when mated with Romney-Rambouillet ewes in the production of California spring lambs.

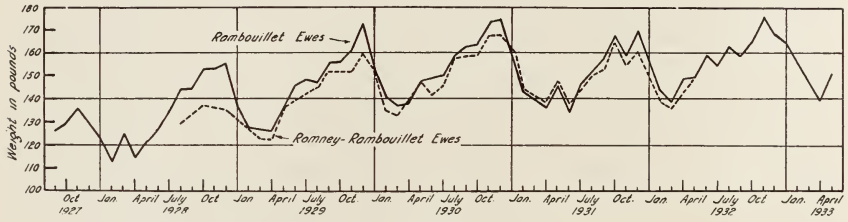

Fig. 5.—Monthly weight of ewes, showing seasonal trend.

During the entire period the average annual death loss of group A (six years) was 4.9 per cent and of group B (four years) was 2.5 per cent. On two occasions a few ewes died from lambing paralysis, though the majority of losses resulted from complications at lambing time. The heaviest losses occurred during the latter part of the experiment when group-A ewes were seven and group-B six years of age. The percentage of ewes that failed to lamb each year was 7.4 in group A and 8.8 in group B. Three ewes in group A and one in group B were discarded because they developed spoiled bags, and these are included in the number having died (table 3).

All the rams proved to be active breeders except the Romney. The latter seemed to be slow and during the fall of 1928 and 1931 failed to settle the ewes, so that the Romney cross had to be eliminated from the experiment for those two years.

The average initial weight of group-A ewes taken on July 1 of each year except 1927 was 143.8 pounds per head, and the final weight taken May 1 of each year was 139.8 pounds. The corresponding weights for group B were 138.8 and 142.2 pounds per head. The May 1 weight was taken soon after the lambs were shipped. The group-B ewes took on flesh more readily in the spring than those of group A, no doubt because

they are more of the mutton type and fatten readily as compared with the fine-wool type of group A.

The Final Weight of Lambs.—There was more or less variation in these weights, resulting from the variation in the age of the lambs. When the average age of each lot was computed, however, the ages were exceptionally uniform. The lambs sired by the Hampshire and Suffolk rams developed more rapidly than those sired by the Shropshire and Southdown. Some of them gained at the rate of 1 pound a day after they were 2½ to 3 months old. There was no appreciable difference between the Hampshire and the Suffolk lambs: one year one lot would have a slight advantage, and the following year the reverse would be true, with both the group-A and group-B ewes. Next in order was the Shropshire cross, followed by the Southdown. The lambs sired by Romneys and Rambouillets, while practically equal to those sired by Southdowns, were criticized for lack of uniformity in weight.

Pounds of Lamb Produced per Ewe.—The production efficiency stands very high in this experiment because of the large percentage of twins raised each year. The average pounds of lamb produced annually for each ewe was 91.4 in group A and 82.2 in group B, when based on the total number of ewes bred. When based on the number of ewes that actually lambed, excluding the dry ewes and those that died, these figures would be 113.2 and 93.3 pounds, respectively.

Grade of Lamb.—The Southdown cross excelled in both groups in that the lambs were very broad, compact, and well covered. The Shropshire, which somewhat resembles the Southdown, was next in order in group A, although in group B, for some reason, they graded below the Hampshire and Suffolk. One objection to the Shropshire cross with the Romney-Rambouillet ewes was that the lambs had a rather long, loose fleece, which gave them an unfinished appearance. There was no significant difference in the grading of the Hampshire and the Suffolk. In both of these crosses there were a few lambs each year that weighed 100 pounds and above, which were penalized for overweight. The Romney cross graded particularly well, although the lambs appeared a trifle uneven, probably because of a loose, open fleece. As the Rambouillet lambs lacked finish and mutton type, they graded considerably lower than the other crosses.

Grade of Carcass.—In group B over a period of four years the Southdown graded 70 per cent Choice, whereas the other lots averaged about 50 per cent Choice carcasses. In group A the grading was somewhat lower, the Southdown cross producing about 50 per cent Choice carcasses, whereas the Shropshire, Hampshire, and Suffolk varied from 25 to 35 per cent Choice carcasses.

The Suffolk carcasses graded considerably lower than the Hampshire in group A, and the Suffolk sire was criticized somewhat for producing a long type of carcass when mated with Rambouillet ewes. In group B, the Suffolk excelled the Hampshire and Shropshire, a fact indicating that the Suffolk is better adapted to crossing with the Romney-Rambouillet ewe than with the Rambouillet ewe.

The lambs sired by Romney rams in group A graded fairly well on foot; in fact, the percentage of Choice lambs was fully equal to the Shropshire, Hampshire, and Suffolk crosses; but when the lambs were dressed, the Romney cross fell far below these other crosses. Apparently the long fleece of wool was somewhat misleading, and the lambs were not as well covered as they appeared to be when graded on foot. The lambs sired by the Rambouillet rams in group A graded mostly Good and Medium, with a small percentage as Choice.

In New York the lambs were graded into Prime, Choice, Good, and Medium, and these grades were subdivided into Top Prime, Average Prime, Low Prime, and so forth. The grade index was consistently higher in New York than at San Francisco, because of a difference in grading standard on the west and the east coast. It indicates that the western standard is higher than the eastern and that the carcasses did not in any way deteriorate in shipment, although they were en route between 4 and 5 days in refrigerator cars.

Sale of Carcasses.—Upon arrival at New York the carcasses were unloaded at one of the Swift & Co. branch houses and were offered to the retail trade. The lighter carcasses of superior quality sired by Southdown rams brought only a little more per hundredweight than those sired by Hampshire and Suffolk. The difference might have been greater except for the fact that many of the larger carcasses, weighing over 42 pounds, were cut and sold by wholesale cuts. This is the customary procedure in order to merchandise these carcasses to advantage. A second point clearly established was that the Rambouillet carcasses sold as well as the Hampshire and Suffolk in group A. The average sale price per hundredweight was $24.94 for the Rambouillet carcasses, $25.41 for the Hampshire, and $24.60 for the Suffolk. This is rather contrary to expectation because the Rambouillet is classed as a fine-wool breed. Evidently the trade does not discriminate very closely provided the carcasses are reasonably well covered.

Comparison of the Two Types of Ewes.—In comparing group-A and group-B ewes, it was definitely shown that early breeding is a breed characteristic, the group-A ewes having bred readily in July and the group-B ewes in August. There was a distinct advantage, however, in having the ewes breed in July so that the lambs would be dropped in

December to insure fat lambs before the feed dried up in the spring. In this test the green feed was becoming scarce every year when the lambs were marketed, and it would have been impractical to carry the lambs any longer.

As to general vigor, both types of ewes were hardy and remained in good condition throughout the test, as shown in figures 6 and 7. The

Fig. 6.—Rambouillet ewes, group A, at the close of the test, aged seven years. Note the body conformation, size of ewes, reasonable smoothness, and thrifty condition.

death loss was somewhat greater in group A, while there was a larger percentage of ewes that did not lamb in group B. At the close of the test, the two types of ewes appeared to be in about the same condition, although the shepherd, Mr. George Philip, considered group A superior in vitality, showing fewer signs of old age.

CONCLUSIONS

Sires of the larger breeds, namely, the Hampshire and Suffolk, produced lambs weighing from 6 to 8 pounds more at 3½ to 4 months of age than sires of the smaller breeds such as the Shropshire and Southdown.

In a comparison between the Hampshire and Suffolk crosses, no significant difference appeared in the final weight of lambs, although the lambs sired by Suffolk rams were a trifle heavier out of the Rambouillet ewes.

Lambs sired by Shropshire rams were approximately 2.5 pounds heavier than those sired by the Southdown in both group A (Rambouillet ewes) and group B (Romney-Rambouillet ewes). The lambs sired by Southdown, Romney, and Rambouillet were practically of equal weight in group A.

In birth weight, the crosses ranked Hampshire, Suffolk, Shropshire, Romney, Rambouillet, and Southdown in group A. In group B the same order prevailed, with the Romney and Rambouillet crosses omitted. The lambs sired by Hampshire and Suffolk averaged approximately 10.5 pounds at birth, whereas those sired by Shropshire and Southdown averaged approximately 9.5 pounds at birth, in both groups.

Fig. 7.—Romney-Rambouillet ewes, first cross, group B, at the close of the test, aged six years. Note the thick compact bodies, freedom from skin folds, and open faces.

In pounds of lamb produced per ewe, the Hampshire cross was credited with 99.0 pounds and the Suffolk cross with 96.5 pounds in group A. In group B the order was reversed, the Suffolk cross averaging 87.6 pounds and the Hampshire 83.5 pounds. The Shropshire cross somewhat excelled the Southdown in this respect in both groups. The Rambouillet cross in group A made a very good showing; it ranked third, with 92.1 pounds of lamb per ewe, partly because of a larger number of lambs raised. The Romney cross in group A was last with 84.2 pounds, but this cross only covered four years and is not strictly comparable to the other lots. In group B the pounds of lamb credited per ewe was somewhat lower than in group A because the lambs were three weeks younger. The crosses ranked Suffolk, Hampshire, Shropshire, and Southdown.

With reference to the grade of lamb on foot, in group A the Southdown cross excelled with a grade index of 4.01 (an arbitrary rating based on the proportion of the various grades; see table 6), followed by the Shropshire, 3.81; Hampshire, 3.76; Suffolk, 3.71; Romney, 3.67; and Rambouillet, 3.08. The group-B lambs ranked Southdown, 3.82; Suffolk, 3.77; Hampshire, 3.71; and Shropshire, 3.50.

In grade of carcass the Southdown and Shropshire crosses excelled the

larger breeds. The grade index for group A at San Francisco was as follows: Southdown, 4.34; Shropshire, 4.16; Hampshire, 3.99; Suffolk, 3.96; Romney, 3.74; and Rambouillet, 3.45. In group B the grade index was Southdown, 4.66; Hampshire, 4.47; Shropshire, 4.45; Suffolk, 4.35.

With reference to the dressed yield, the Southdown and Shropshire crosses excelled in group A with a killing percentage of 51.6 and 51.0 respectively, as compared with 50.0 for the Suffolk cross, 49.9 for the Hampshire, 48.9 for the Romney, and 48.4 for the Rambouillet. In group B the dressing percentages were Southdown, 52.1; Hampshire, 51.3; Shropshire, 51.2; and Suffolk, 51.1.

In the final sale at New York the carcasses of the Southdown and Shropshire crosses brought a somewhat higher price per hundredweight than the Hampshire and Suffolk crosses, no doubt because of superior grade and lighter weight. The Hampshire carcasses realized a better price per hundredweight than the Suffolk, and the Rambouillet carcasses sold almost as high as the Hampshire.

The final return per carcass at New York was in favor of the Hampshire cross, which excelled the Suffolk because of a higher sale price. The ranking in this respect was Hampshire, Suffolk, Shropshire, Southdown, and Rambouillet in group A. The same relation existed in group B except that the Southdown surpassed the Shropshire.

In a comparison between the dams, Rambouillet ewes (group A) were superior to Romney-Rambouillet (group B) in earliness of breeding. The lambs out of the Rambouillet ewes were 21 days older, weighed 9 pounds more at market time, and brought 91 cents more per carcass in the final return than those out of the Romney-Rambouillet ewes.

The group-A ewes produced an average yearly wool clip in the grease of 13.5 pounds per head, while the group-B ewes produced 10.8 pounds; but on a scoured basis the two groups were practically equal in annual wool production.

The group-A ewes produced 76.1 per cent twins; the group-B ewes, 61.6 per cent, based on the ewes that actually lambed. There was a greater death loss of lambs in group A; the respective percentages of lambs raised were 132.2 and 128.5, based on the total number of ewes in the flock.

In final weight the lambs out of group-A ewes averaged 74.4 pounds; those out of group-B ewes 65.4 pounds. This difference largely resulted from the difference in age.

The grade indexes for lambs on foot were about the same in the two groups. In grade of carcass, however, the group-B lambs were superior, with a grade index of 4.43 as compared with 3.99 for group A.

The dressing percentage and the final sale price per hundredweight of

dressed lamb were in favor of the group-B lambs, though the group-A lambs yielded a greater financial return because of the greater weight.

This test demonstrated two things rather strikingly—first, that the early-breeding quality of the Rambouillet ewes was an important factor in spring lamb production; second, that the trade did not discriminate sufficiently in weight and quality of carcass to permit the choice Southdown lamb to compete favorably with the larger, coarser Hampshire or Suffolk lamb in terms of gross income.

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